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RESEARCH NOTE NOR-14

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SOME EFFECTS OF LOG JAMS AND FLOODING IN A SALMON SPAWNING STREAM[1/]

by
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Log or debris jams are common in salmon spawning streams of southeast Alaska, and often affect streamflow and streambed topography. A study of these effects was begun on Maybeso Creek, Prince of Wales Island, 45 miles west of Ketchikan, Alaska. Log-debris jams were constructed at two areas, and three areas were selected as experimental controls (fig. 1). Streambed gravel composition and topography and dissolved oxygen concentration of intragravel and surface water were measured in 1961 before and immediately after jam construction. Columns of ping-pong balls were placed in the gravel before jam construction to determine the depth of gravel movement. Final observations and measurements were made in 1962 after unexpected high streamflow in the fall of 1961 had washed out the jams.

1/ A condensation of an unpublished report by Daniel M. Bishop and S. Philip Shapley on file at the Northern Forest Experiment Station.

Figure 1.--Location of the five study areas on Maybeso Creek.

Areas 1 and 2: Log debris jam construction sites.

Areas 3, 4, 5: Experimental control areas.

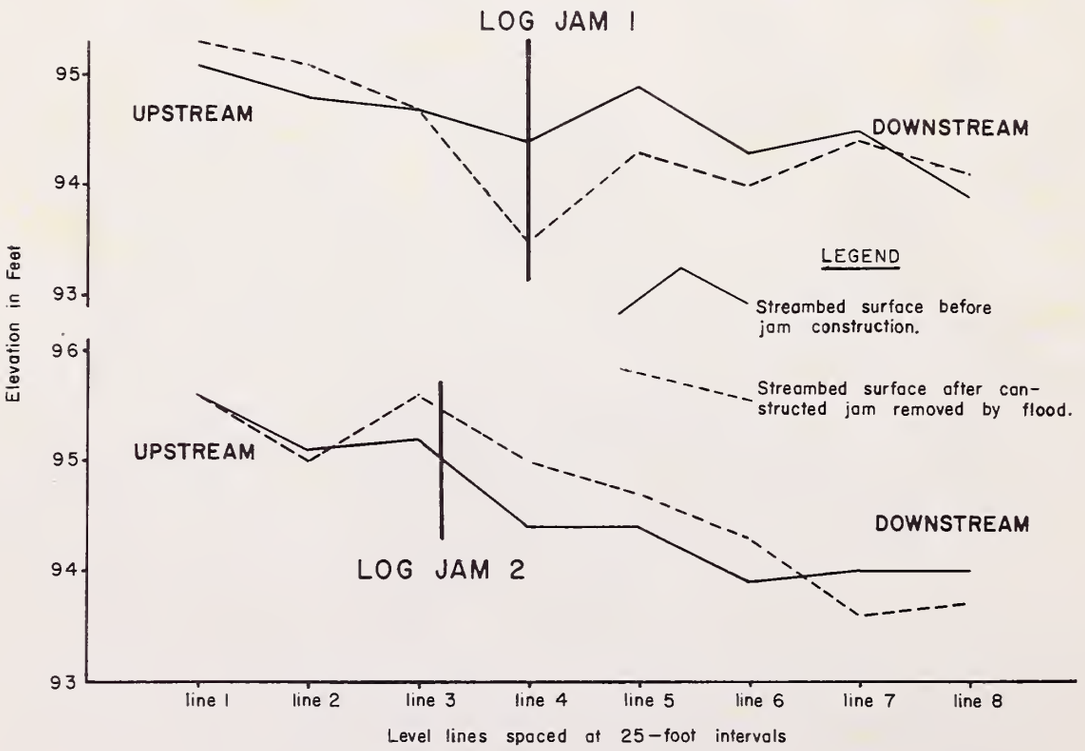

Figure 2.--Streambed profile before log jam construction and after jam removal by flood.

RESULTS

A shallow pool in area 1 deepened after log-debris jam construction and a pool formed under the constructed jam in area 2, apparently during intermediate and higher streamflows. Upstream edges of both pools were steep and unstable.

Record high water on October 14, 1961 (3,800 cu. ft./second on a 15.1-square-mile watershed) forced most of the area 1 debris jam under a large anchoring windfall. The windfall remained in place, however, keeping flow velocities beneath it high enough to prevent filling of the pool by bedload (fig. 2).

Flood waters also washed out the area 2 log-debris jam. Immediately after washout, deposition occurred in the area of slower flow directly upstream from the previous deposition zone.

Of the 137 columns of ping-pong balls, installed to determine the depth of gravel movement in the log-debris jam and control areas, only 15 were recovered. Evidently scouring removed the balls, or perhaps they had been buried too deeply. Considerable gravel movement appears to have occurred.

The amount of fine material (less than 0.833 mm diameter) in the top six inches of streambed was less after flooding than before in four of the five areas and unchanged in the other (table 1). The flood flow evidently had more effect on removal of fine material than did the introduction of jams, though perhaps the exceptionally high flood flows masked changes due to the debris jams.

Table 1.--Fine material in the surface 6 inches of streambed before and after high streamflow

Date of sample	Percent of streambed material (by volume) passing 0.833 mm sieve in five study areas				
	1-jam	2-jam	3-control	4-control	5-control
July 1961	13.4	12.9	5.3	16.3	8.4
May 1962	13.4	1/ 8.4	4.2	2/ 12.1	6.3

1/ Difference from July 1961 significant at 5 percent level.

2/ Difference from July 1961 significant at 1 percent level.

Dissolved oxygen concentration of intragravel water was higher in area 1 and area 2 after the flood than before. The concentrations, expressed as percentages of amounts in surface water, were as follows:

Observation date	Study area 1	Study area 2
July 1961	67% (21 samples)	93% (19 samples)
June 1962	96% (24 samples)	97% (30 samples)

In area 2 the initial level was near that of surface water. Firm conclusions about the relationship of floods to dissolved oxygen would require additional information concerning seasonal changes in streambed oxygen levels.

SUMMARY AND CONCLUSIONS

Streambed scouring and deposition occurred in the areas of two constructed log-debris jams. Gravel shifting associated with jams and flood flows reduced the fine material content of the streambed gravel and may have been responsible for the increased dissolved oxygen concentration.

Log-debris jams intensify streambed instability, especially during floods. They may reduce salmon production in otherwise favorable areas. Gravel movement presumably reduces egg and larvae survival. On the other hand, loss of fine material because of gravel movement should benefit the salmon development environment by improving intragravel waterflow, thus increasing dissolved oxygen availability and making possible more effective removal of metabolic wastes. The effect of log-debris jams on salmon production remains undetermined. From a conservative viewpoint, however, temporary or unstable jams are judged to be detrimental.

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